

8-1-1980

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Charles C. Humpstone

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Recommended Citation

Charles C. Humpstone, *New and Promising Ultimate Disposal Options, Toxic and Hazardous Waste Disposal*, 8 B.C. Env'tl. Aff. L. Rev. 961 (1980),
<http://lawdigitalcommons.bc.edu/ealr/vol8/iss4/9>

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BOOK REVIEW

HAZARDOUS WASTE DISPOSAL

NEW AND PROMISING ULTIMATE DISPOSAL OPTIONS, TOXIC AND HAZARDOUS WASTE DISPOSAL, Volume 4, edited by Robert B. Pojasek. Ann Arbor Science Publishers, Inc., The Butterworth Group, Ann Arbor, 1980, Pp. 313.

*Reviewed by Charles C. Humpstone**

One recent newspaper report quoted a practitioner, less scrupulous than Dr. Pojasek's contributors, explaining that his favorite hazardous waste disposal technique required only that he wait for a bad rain or snow storm and then drive his tank truck of wastes along a highway with the valves open. He only had difficulties with the law, he said, when his escaping cargo dissolved tires and windshield wiper blades on the vehicles behind him.

The eighteen chapters in this compilation present the other, and less publicized, end of the hazardous waste disposal spectrum, an assortment of alternative technologies. The chapters began as papers presented by their respective authors at the International Symposium on Hazardous Waste Disposal sponsored by the American Chemical Society in Honolulu in April, 1979. Although the book was not intended for the purpose, this review will consider the collection's utility as a lawyer's introduction to waste disposal technology.

The chapters make up a very mixed bag. Some authors are de-

* Mr. Humpstone is the President of Environmental Risk Assessment Service (USA) in Boston, Massachusetts.

fending their scientific or commercial turf; others are urging new commercial exploitation of processes showing only experimental promise. The better chapters reward a careful reading, the worst of them induce a fitful sleep. The reader come lately to consider hazardous waste disposal technology will suffer from a lack of an evaluative chapter, some weighing of competing claims, or questioning of assumptions, so that the collection could help him to compare competing claims critically. The volume's title to the contrary, the options discussed for the most part are not new and in several cases not very promising. Some chapters do not deal with distinct "options" at all but with improving operating procedures. Collectively, however, they will acquaint their reader with most of the technologies and precautions now being used to dispose of chemical and other industrial wastes by the licit hazardous waste disposal industry, and with at least the first candidate successors to these technologies.

The chapters fall into four categories. One third are discussions of technologies now widely used. One third discuss a single technology, now just coming into large scale use. The remaining third discuss technologies now in limited use or proposed new technologies. One chapter describes the electric power generating industry's own waste disposal research program.

Current hazardous waste disposal technology falls into five general categories: deposit of dry wastes into landfills designed to prevent contaminant from leaching out, injection of liquid wastes into underground porous rock strata, fixation of wet or dry wastes into insoluble solids by bonding them physically or chemically with other materials before landfilling them, incineration of organic wastes, and gradual decomposition of biodegradable organic wastes in surface soil. Three of the chapters deal with conventional chemical landfills, two with incineration, six with waste fixation, two with composting and landfarming, and one with deepwell injection.

The widely used technologies are landfilling (three chapters), incineration (four chapters), and deepwell injection (one chapter). However, the number of contributors (seven) dealing with waste fixation is a crude indicator of growing interest on the part of the waste disposal industry, its customers, and its regulators in avoiding a future of proliferating underground deposits of toxic materials in biologically active forms. The following discussion will, for the most part, be limited to the chapters that seem to the reviewer the better ones in each class.

To begin with landfills (the most widely used current technology), the best short discussion is R.A. Johnson's *Secure Landfills for Chemical Waste Disposal*. It is very short, clear, and describes all the significant elements of siting, designing, and operating a modern chemical landfill. It shares with the other landfill chapters, however, an unqualified optimism that if all the prescribed precautions are taken, the landfilled wastes will remain perpetually contained. There is only a hint of unease; monitoring wells would "detect any leakage should it occur." A sceptic might suggest that institutional machinery for ensuring that someone will be around to test the liquids in the monitoring wells in perpetuity and will be able to take remedial action, is nowhere in sight. Even the largest corporations are vulnerable to decay and death. The appearance of perpetual stability clothing government itself looks less substantial when one considers the size of our national defense budget and the urgency with which its advocates seek to enlarge it. Apart from this optimism though, the chapter provides a useful guide.

Three of the chapters on waste stabilization stand out above the others.

In *A Solid Future for Solidification/Fixation Processes*, D.C. Christensen and W. Wakamiya give a concise and lucid summary of the opportunities and technology for waste fixation in nontechnical language. After describing fixation processes in general, the authors recite specific test results for several proprietary processes applied to different wastes. All the fixation processes reviewed are successful in reducing leaching in inorganic contaminants to very low levels. They are much less successful in fixing certain organic pesticides where concentrations may be reduced 100 to 1,000 times but still remain too high in light of their biological implications.

The closing portion of *A Solid Future* does not match its beginnings. The authors pursue the results of Kepone-fixation experiments and are drawn into enthusiastic but unconvincing speculation over the possible utility of molten sulfur and epoxy grout as fixation agents for organic wastes.

Leachate Testing of Hazardous Chemicals for Stabilized Automobile Wastes by McClelland, Maring, McGowan, and Bellen describes test results on only one proprietary fixation process and the article labors somewhat under its promotional burden. The test program, although carried out by the authors for an independent, non-profit research organization, was sponsored by the owners of the proprietary process. The chapter is also heavy going for a

reader without a technical education or at least some familiarity with chemical testing procedures. Its reward lies in an almost hidden drama. The punch line is not in the text at all but in a series of tables that show the stabilization process growing dramatically more effective as time passes and the mixture sets. In its untreated form the automotive industry waste being treated went into solution in toxic concentrations easily; after twenty-eight days of curing time, the laboratory tests that simulate natural leaching of rain water through the material showed such low concentrations of contaminants that the leachate was within the limits for potable water set by EPA's Drinking Water Standards. The following chapter, *Land Reclamation with Stabilized Industrial Wastes*, by J. T. Schofield, describes the use of the same process to convert hazardous wastes to inert material similar in appearance to concrete. The treated wastes in each case are placed, not in an engineered chemical landfill but in land previously denuded by strip mining. Three facilities are in operation in England; another is being planned; one also started operation in Japan during 1979. A similar project, the largest to date, is under development in Groveland, Michigan.

Of these three articles, only the first hints at the range of the unknowns that still must temper enthusiasm for waste fixation. The testing procedures carried out over up to twelve weeks seek to simulate the effect of rainfall leaching through soils. They do so to only a limited degree. So far, testing procedures do not attempt yet, for example, to simulate the effects of summer and winter, repeated freezing and thawing, or prolonged periods of rain and drought. Least of all can they mimic the prolonged passage of time itself. The last word on hazardous waste stabilization may never be written. For the reader addressing the subject for the first time, however, these are a helpful and encouraging introduction.

Unfortunately for someone looking for an introduction to hazardous waste incineration technology, the substance of the only article on conventional incineration, *Ultimate Hazardous Waste Disposal by Incineration* by J. C. Reed and B. L. Moore, bears no relation to its title. It is an extremely technical attack on a proposed EPA flue gas monitoring procedure, and a proposal for a more effective alternative. It is heavy going for the uninitiate and provides no general description of the opportunities or techniques for incineration.

The reverse is true of R. W. Amstutz's exemplary article *Deep-Well Disposal: A Valuable Natural Resource*. Mr. Amstutz's piece

is the best in the book, a very informative explanation of deepwell injection technology, when and where to use it, and the extent of its current use. Alone among the authors, he conveys a sense of the limitations of the disposal process he describes, its reliance on extensive and reliable geological data, and the need for redundant engineered safeguards to ensure that the material to be injected does not stray from its intended reservoir.

D. E. Ross and H. T. Phung's *Soil Incorporation (Landfarming) of Industrial Wastes*, is almost as good. Much the better of two articles on the subject, it describes the procedures by which some hazardous organic wastes can be prepared and tilled into surface soils in such a way that they decay into harmless materials either through biological or photochemical degradation or chemical change.

The article contains a straightforward description of landfarming operating procedures and the characteristics that qualify a waste for such treatment. (By the authors' calculation, landfarming is applicable only to about 3 percent of all industrial wastes.) It explains the risks implicit in landfarming with detachment.

The remaining articles on established or recently commercialized disposal procedures have in common that their authors combine pedestrian restatements of the national hazardous waste disposal problem with uncritical advocacy of one or another technology. Each author avoids discussing the weak points and possibilities of potential failure of the method he promotes.

The proponents of the newest untested technologies are even less inclined to consider what might go wrong. In *Ocean Incineration of Toxic Chemical Wastes*, M. Halebsky writes fifty-two pages on the benefits of putting chemical waste incinerators onto ships without once mentioning pilot error, tide, wind, fog, reefs, engine failure, or the risk of collision. Four-fifths of the article is expended on cataloguing industrial wastes by sector and region to demonstrate how many ocean-going incinerator vessels might find employment. There is no acknowledgement that such employment might be materially affected by the perils of the sea.

The collection's only article on radioactive wastes, N. Sonenshein's *Seabed Disposal of Radioactive Waste—A Prime Alternative*, is somewhat more circumspect but more of an argument for further research and development than a call for immediate ocean-floor disposal. It, too, however, skirts any discussion of the nature and consequences of potential failure.

The discussion of experimental incineration technology in *Disposal of Hazardous Wastes by Molten Salt Combustion* by Yosim, Barclay, Gay, and Grantham suffers primarily from the authors' failure to recognize the materials handling and waste feed problems that have been encountered in other molten salts incineration projects. Maybe the problem is inbreeding. Only one of the six references cited described work in which one or more of the authors of this article were not involved. Maybe the problem is this reviewer's residual chagrin over his own participation in EPA's first attempt to use molten salt incineration to dispose of sanitary wastes from Alaskan native villages in satisfaction of Section 113 of the Federal Water Pollution Control Act (33 U.S.C. 466 et seq.). The pilot plant exploded shortly after the wastes specified hit the fan.

CONCLUSION

To summarize the volume, a reader looking for an introduction to hazardous waste disposal technologies will find what he needs for all major technologies except incineration, but part or all or many chapters will be slow going, not worth the effort they require.